EFFECTS OF A LOW-LEVEL DIELDRIN APPLICATION ON A RED-WINGED BLACKBIRD POPULATION

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In May 1964, an irruption of army worms (*Pseudaletia unipuncta*) was detected in wheat and barley fields of southern and central Illinois. Through news media, entomologists in the state recommended that heavy infestations of the worms be treated with dieldrin at the rate of one-eighth to one-fourth pound per acre, but cautioned that insecticides should *not* be used unless the number of worms was at least six per linear foot of drill row. Many farmers in Illinois contracted to have their small-grain fields sprayed. Among the fields treated were several on a pheasant research area near Neoga, Cumberland County, Illinois. Between 25 and 27 May, about 1,000 acres in the Neoga area were sprayed by airplane; the spray was formulated from dieldrin emulsion concentrate in water, and the rate of application was one-fourth pound of the active insecticide per acre.

Because Scott et al. (1959:426) had observed heavy mortality of birds in Illinois, resulting from agricultural applications of dieldrin at the rate of 3 pounds per acre, we were interested in learning whether applications in relatively low concentrations would have any notable effect on a local bird population.

We had no opportunity to plan the study prior to the dieldrin application, for spraying was already under way in the area on 25 May, when we learned about it. Fortunately, Wunderle had taken an interest in the local Red-winged Blackbird (*Agelaius phoeniceus*) populations in the course of his spring field studies on pheasants in the Neoga area. He was doing fieldwork in the area when the spraying operation began and made some observations on the behavior of redwings while the fields were being sprayed.

Only wheat was intentionally treated, but fields adjacent to the treated wheat fields probably received some spray from drift due to wind. Wheat fields in Illinois support very low populations of nesting birds (Graber and Graber, 1963:408), but many of the wheat fields in the area were next to hayfields which supported very dense bird populations (op. cit., 416). Thus, we chose for study a 10-acre hayfield located next to a sprayed 20-acre wheat field. On 25 May, the date the wheat was sprayed, wind was light (10 knots or less) from the southwest. Our hayfield study area was immediately north of the sprayed wheat and almost certainly received some drifting insecticide. This is the only sense in which the hayfield was "treated," but here after we shall refer to it as the treated field.

For purposes of comparison we selected another 10-acre hayfield in which to make observations on nesting success of redwings. This "control" field was located 2 miles north–northeast of our treated field and 2 miles from the *nearest* known dieldrin-treated field.

Three species of birds, the Red-winged Blackbird, Eastern Meadowlark (*Sturnella magna*), and Dickcissel (*Spiza americana*) were common in the Neoga hayfields, but we concentrated our observations on redwings because their nests are easily found. We made observations, searched for nests, and collected specimens in the treated field on 25, 26 May and 1, 9, 15, 18, 22, and 29 June, and in the control field on the June dates. We located nests by systematically walking the fields. Coverage was fairly thorough, though we probably overlooked some nests.

Analysis of specimens was carried out by Bruce, Jeanne Wilson, and other staff of the Economic Entomology Laboratory of the Illinois Natural History Survey, using the extraction and cleanup method described below, and gas chromatography (Coulson et al., 1959:250). In the processing of specimens for analysis, 25–50 grams of tissue were cut from the bird body, blended in 10 per cent acetone in hexane, and extracted. The sample consisted mainly of muscle and bone, but included a small amount of feathers and tarsus. From one specimen, only the stomach contents and liver were analyzed. Otherwise, viscera were not included in the tissue analysis. Shells of egg specimens were not used, and the contents of four to six eggs (10–15 grams of tissue) were combined and processed as a single specimen. The extracts were digested in potassium hydroxide and ethanol, extracted with hexane and ether, and dried over sodium sulfate. Fats were saponified with potassium hydroxide, extracted and cleaned up on magnesium oxide and Florisil. Each specimen was analyzed on two different columns and two different gas chromatographs with electron capture apparatus. Separation of DDE and dieldrin was accomplished with a polar column (Shell Epon Resin 1001 on Chromosorb W.). Standards were analyzed with every set of samples, but determinations were not verified by any other method. As used, the method will detect a variety of chlorinated hydrocarbon and organophosphate insecticides. Because the laboratory had numerous other commitments, only a small number of bird specimens were analyzed. We undertook the work primarily as a pilot study to familiarize ourselves with the problems involved. The data proved interesting and we felt they should be placed on record.

As early as 27 April 1964, Wunderle and Graber had observed redwings building nests in the vicinity of Neoga. The females that were building, however, represented only a small part of the total redwing population in the area. So far as we could determine, nests were being constructed only where there were good stands of cattails (*Typha*) or in woody cover, particularly young stands of willow (*Salix*). Redwings of both sexes were also present in hayfields, but their behavior was not that of birds with nests, and though we searched at least three fields, we found no nests. Presumably the hay plants were still too low or sparse for suitable nesting cover. Subsequent observations indicated that a small number of redwings began nesting in the hayfields in early May, whereas the bulk of the population did not begin nesting until mid-May or later. These observations were made within a few miles of the fields that we later chose to study, but no observations were made at the treated field

TABLE 1

INSECTICIDE RESIDUES IN EGGS AND YOUNG OF AGRICULTURE-ASSOCIATED RED-WINGED BLACKBIRDS COLLECTED NEAR NEOGA, ILLINOIS, JUNE 1964, FROM ONE DIELDRIN-TREATED FIELD AND ONE UNTREATED FIELD

Specimen	Age	Number of spec.	Time of Collection: Days after treatment	Field	Dieldrin (ppm)	DDE (ppm)	Remarks
Eggs	Fresh*	6 (from 6 nests)	7	Control	1.7	0.0	At least 50% hatch from these nests.
Eggs	Fresh	6 (from 6 nests)	15	Control	1.7	0.0	At least 50% hatch from these nests.
Eggs	Fresh	5 (from 5 nests)	15	Treated	5.7	0.0	All nests failed, apparently deserted.
Eggs	Fresh	6 (from 6 nests)	21	Treated	6.3	0.0	All nests failed, apparently deserted.
Eggs	Fresh	4 (from 4 nests)	28	Treated	0.2	0.0	Nests destroyed by harvest.
Juvenile	15 days	1	15	Treated	3.4	0.0	Appeared healthy.
Juvenile	Neonate	1	24	Control	0.2	0.2	Appeared healthy.
Juvenile	2 days	1	24	Control	0.0	0.0	Appeared healthy.
Juvenile	5 days	1	24	Control	0.1	0.1	Appeared healthy.
Juvenile	9 days	1	24	Control	0.1	0.1	Appeared healthy.
Juvenile	25 days	1	24	Control	0.3	0.2	Poor condition.

* Incubated no more than 1 day.

itself until 25 May when the dieldrin was applied. On both 25 and 26 May, Wunderle made observations on birds in the treated hayfield. There were at least 25 redwings in the field. Some of the birds actually flew into the adjacent wheat to forage as the spray was being applied, and birds at the south edge of the hayfield probably contacted drifting spray also. We do not know whether or not the redwings were feeding on army worms at this time. The stomach of an adult male collected 22 hours after the treatment contained no army worms but was packed with small dark beetles, probably curculionids from the hayfield. The stomach and liver of this redwing contained about three ppm of dieldrin and two ppm of DDE (a DDT metabolite). So far as we know, no DDT had been used recently in the immediate area, and the DDE residue is indicative of the omnipresence of DDT in the environment. Before the male was shot, his behavior seemed normal; he was aggressive, calling, and giving territorial displays. On 25–26 May, the treated population in general was active and normally aggressive, the birds giving alarm calls and making flight "attacks" on the observer. No nests were found in the hayfield at this time, though nests in the very early stages of construction could easily have been overlooked. We feel certain that at least one nest *was* overlooked, because 2 weeks later we found a stub-tailed juvenile (Table 1) which was almost certainly hatched in the treated hayfield about the day of the spraying. The survival of this juvenile in apparent good health is somewhat puzzling in view of our subsequent observations.

The population and its behavior changed drastically by 1 June, when no more than 11 redwings were left in the field. The birds were quiescent; they made no attacks, and uttered no alarm calls. In a search of the field we found only five nests, all in the same half-finished stage of construction. The nests, which had been placed in the taller, more robust plants in the field, appeared to have been started about the day of the spraying or shortly after. At a more fragmentary stage they could have been overlooked on 25 May, and so it is possible they were *initiated* even before the spraying. (Allen, 1914:98, found that nest construction by redwings usually requires 6 days.) Subsequent observations showed that these nests were never completed. Redwings are extremely sensitive to intrusion during the nest-building period (Allen, 1914:98), and the nests we found may have been deserted because we walked near them. However, the obvious apathy of the population suggests that the nests had already been deserted when we found them. They were probably deserted after 26 May and before 1 June. This desertion, the marked population decline, and the change in behavior of the remnant population led us to conclude that at least some of the birds in the initial resident group were killed by the dieldrin spray. We found no dead redwings, but an emaciated adult male (testes much enlarged) meadowlark which we found dead in the same hayfield on 1 June contained 5.6 ppm of dieldrin. Whether or not this represents a lethal level is unknown. A road-killed meadowlark picked up outside (but near) the treated area the same day had only 0.2 ppm of dieldrin.

On 1 June we searched the control field for the first time and found seven nests. The number of nesting redwings was always higher in the control than in the treated field, but little weight can be attached to these population differences, because densities of bird populations in hayfields are highly variable from field to field (Graber and Graber, 1963:416). Though we may have overlooked some nests in the control field, the nests we found showed that the redwing tenants were all in about the same stage of the reproductive cycle; i.e., they were laying. The nests had incomplete clutches, and none of the eggs showed obvious signs of incubation (established by candling). Our data suggest that the nesting cycle was fairly well correlated between birds of the treated field and birds of the control field up until the time of the treatment. Thus, most of the females in the control field were just starting to lay eggs on 1 June, and, as near as we can judge from our incomplete data, this is probably the stage the treated birds would have reached in early June had they not deserted. (Egg-laying in the redwing usually follows immediately the completion of the nest, Allen, 1914:99.)

In the control field on 1 June, we collected one fresh egg from each of six nests. These eggs contained 1.7 ppm of dieldrin. On 9 June another sample of six fresh eggs (six nests) was collected from the control field and these also showed 1.7 ppm dieldrin (Table 1). Four of the nests from which we took eggs failed, either because of our interference or natural predation, but at least 50 per cent of the eggs in the remining nests hatched; we did not learn the fate of every egg, and hatching data are based on the presence of nestlings on subsequent dates. The source of the dieldrin in the control field is unknown. Territories of breeding redwings are not large (average: one-twelfth acre. Nero, 1956:149), and nesting birds probably do not fly 2 miles to forage. Whether or not wind drift could account for such broad distribution is also unknown, but, obviously, dieldrin was widely spread in the environment.

On 9 June we also searched the treated field again. Besides the unfinished, deserted nests which were still in place, we found nine new nests, four newly completed but empty, and five with fresh eggs. We collected one egg from each nest, and found that they contained 5.7 ppm of dieldrin (Table 1). On 15 June we found that all of these nests had failed. Though the cause of failure is unknown, our interference was probably a contributing factor. Besides the abandoned nests we found six new nests and collected one egg from each for analysis. They contained 6.3 ppm dieldrin (Table 1). Subsequent observations again showed that these nests failed to produce young. Between 25 May (date of spraying) and 22 June, so far as we could determine, redwings in the treated field hatched only one young, the fledgling which had hatched about the day of the spraying. When we found it, the juvenile was about 15 days old: it appeared healthy and flew well. When analyzed, its tissues were found to contain 3.4 ppm dieldrin. Redwings in the control field, on the other hand, produced many young (at least 43 nestlings and fledglings) by mid-June.

After 1 June we did not notice any marked change in the redwing population of the treated field, though the number of redwings in the control field increased steadily until, on 18 June, there were 23 nests, all simultaneously active. This influx may have occurred as a consequence of hay cutting in the area, which was steadily reducing the amount of available habitat for redwings. In the treated field, between 25 May and 15 June, there were three apparent "waves" of nesting attempts: (1) the initial five nests that were started about the date of treatment and subsequently deserted before completion, (2) the new nests of 9 June with eggs that contained 5.7 ppm dieldrin, and (3) the new nests of 15 June with eggs that contained 6.3 ppm dieldrin. How many different birds were involved in these nesting efforts we can only surmise. On the basis of population and behavioral changes we suspected that the initial group of nesting redwings either died or moved. The second and third groups of nests were so closely spaced in time (a maximum possible interval of 6 days between nest failure and egg laying) that they almost certainly represented different birds. On 22 June we noted that there had been a marked increase in the redwing population of the treated field since the 15th, and in searching the field we found eight new nests in various stages of construction, four nearly completed. In addition, we found five new nests with eggs, and collected fresh eggs from four of them. These eggs, laid 28 days after the spraying, were nearly free of dieldrin (Table 1). The abrupt diminution of dieldrin residue in eggs between the 21st and 28th day after treatment is puzzling. Precipitation in the Neoga region increased after mid-June and may have had some effect on the distribution of dieldrin in the local environment. There may also have been an influx of birds from outside the spray area.

Juveniles from the control field had a low dieldrin content and showed little tendency to increase dieldrin content with age (Table 1). The presence of DDE in young redwings is interesting because the eggs were free of DDT or DDE contamination (Table 1). So far as we could learn, no widespread use of DDT occurred during the study. There are various possible explanations for the abrupt appearance of DDT in the young birds: drift from distant spraying, seasonal emergence of contaminated organisms from the soil, or a change in foraging habits of adult birds between the time the eggs were laid and the time they hatched.

Our data suggest that even low concentrations of dieldrin, widely spread, may have a notable effect on bird populations within the first 2 or 3 weeks after the application. Hatchable eggs with 1.7 ppm of dieldrin, and an active juvenile with 3.4 ppm, give some indication of the tolerance of redwings for the insecticide. In order to evaluate with any precision the ultimate effects of pesticides on bird populations, we need to know much more about both the environmental and biological distribution of these chemicals.

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NEW LIFE MEMBER

Mr. Fred T. Hall, a former Secretary of the Society, has recently become a Life Member of the Wilson Ornithological Society. Mr. Hall is Director of the Buffalo Museum of Science, Buffalo, New York, where he has made notable contributions to the fields of science education and conservation. His principal ornithological interests have been in making color movies of birds and in painting birds. The picture shows him beside his painting of the Cahow. In 1945 Mr. Hall was one of the discoverers of the still extant population of this supposedly extinct species.

Mr. Hall was educated at Wabash College, and Rochester Institute of Technology, and served as an officer in the U.S. Army. He is a member of the A.O.U., Buffalo Audubon Society, Genessee Ornithological Society (both of which he has served as president) and several museum associations. He is currently President of the Association of Science Museum Directors.

Mr. Hall is married and has five children.